

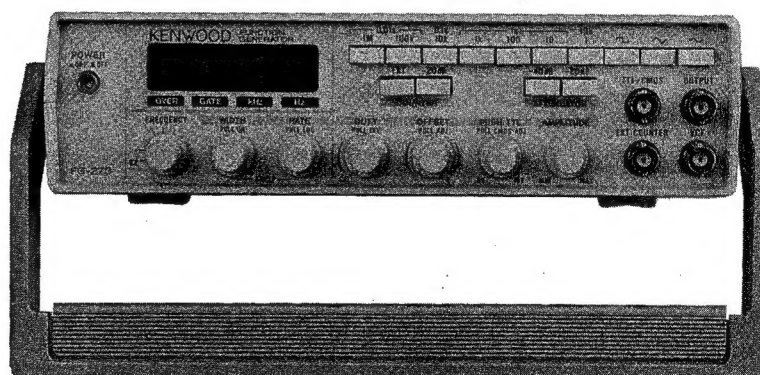
KENWOOD

FUNCTION GENERATOR

FG-273

SERVICE MANUAL

KENWOOD CORPORATION



WARNING

The following instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

CONTENTS

SPECIFICATIONS	3
SAFETY	5
ADJUSTMENT	6
PARTS LIST.....	8
SCHEMATIC DIAGRAM.....	11
P.C. BOARD	14

SPECIFICATIONS

Frequency Characteristics	
Outputs	Sine, square, triangle, pulse, ramp, TTL/CMOS square wave
Frequency range	0.02 Hz to 2 MHz in 7 frequency ranges (1/10/100/1k/10k/100k/1M)
Accuracy (1)	± 1 digit, 4-digit max. (digital readout to output frequency)
Accuracy (2)	$\pm 5\%$ of full scale (0.2 Hz to 2 MHz) (frequency dial to output frequency)
External frequency control (VCF)	
Input voltage	0 to +10 V DC. Frequency decreases with positive voltage
Variable frequency range	Greater than 1000:1
Variable symmetry	Variable over 1:1 to 40:1 range
DC offset	Continuously variable, maximum of ± 10 V open circuit, ± 5 V into 50 ohms.
Polarity	Inverted or non-inverted
Sine Wave	
Distortion	Less than 1%, 10 Hz to 100 kHz
Amplitude flatness	Within ± 1.0 dB to 100 kHz at maximum output amplitude
Output	Variable amplitude
Square Wave	
Symmetry	Less than $\pm 3\%$ at 100 Hz
Rise and fall time	Less than 100 ns at maximum output
Output	Variable amplitude
Triangle Wave	
Linearity	Less than 1% at 100 Hz
Output	Variable amplitude
TTL Output	
Rise and fall time	Less than 25 ns
Output	TTL level
CMOS Output	
Rise and fall time	Less than 60 ns
Output	+5 to +15 V, continuously variable
Sweep Characteristics	
Internal	Linear or logarithm
Sweep rate	0.5 Hz (2 s) to 50 Hz (20 ms), continuously variable
Sweep width	Variable from 10:1 to 1000:1
External sweep	Front panel VCF jack, Input impedance is 11.5 k Ω .

SPECIFICATIONS

Frequency Counter Characteristics	
Frequency range	5 Hz to 10 MHz (10 s, 1 s, 0.1 s, 0.01 s)
Accuracy	± 1 count time base accuracy
Stability	Less than ± 20 ppm, 0°C to 40° C
Input sensitivity	30 mV rms, 5 Hz to 10 MHz
Maximum input voltage	150 V rms at 1 kHz
Input impedance	Approx. 500 k Ω [0 dB], Approx. 1 M Ω [20 dB]
Output	
Amplitude	20 Vp-p Open circuit, 10 Vp-p into 50 ohms.
Attenuator	Steps of -20 dB, -20 dB and -40 dB. Continuously variable
Impedance	50 ohms, $\pm 10\%$
Power Requirements	
Input voltage	AC 100 V/120 V/220 V/240 V $\pm 10\%$
Frequency	50 Hz/60 Hz
Power consumption	Approx. 20 VA
Environmental Conditions	
Storage	-20°C to 60°C, Less than 70% humidity
Operating	0°C to 40°C, Less than 80% humidity
Specification	23°C $\pm 5^\circ$ C, Less than 70% humidity
Dimensions and Weight	
Dimensions	240 (W) \times 64 (H) \times 190 (D) mm
Weight	1.8 kg
Accessories	
Instruction manual	$\times 1$
AC cord	$\times 1$
Fuse	0.3 A (slow-blow type) $\times 1$ 0.2 A (fast-blow type) $\times 1$

* Circuit and rating are subject to change without notice due to developments in technology.

SAFETY

SAFETY

Before connecting the instrument to a power source, carefully read the following information, then verify that the proper power cord is used and the proper line fuse is installed for power source. The specified voltage is shown near of the AC inlet. If the power cord is not applied for specified voltage, there is always a certain amount of danger from electric shock.

Line voltage

This instrument operates using ac-power input voltages that 100/120/220/240 V at frequencies from 50 Hz to 60 Hz.

Power cord

The ground wire of the 3-wire ac power plug places the chassis and housing of the instrument at earth ground. Do not attempt to defeat the ground wire connection or float the instrument; to do so may pose a great safety hazard. The appropriate power cord is supplied by an option that is specified when the instrument is ordered. The optional power cords are shown as follows in Fig. 1.

Line fuse

The fuse holder is located on the rear panel and contains the line fuse. Verify that the proper fuse is installed by replacing the line fuse.

Voltage conversion

This instrument may be operated from either a 100 V to 240 V, 50/60 Hz power source. Use the following procedure to change from 100 to 240 volt operation or vice versa.

1. Replace fuse FS1 with a fuse of appropriate value, 0.3 A slow-blow type for 100 VAC to 120 VAC operation, 0.2 A fast-blow for 220 VAC to 240 VAC operation.
2. Reinsert it for appropriate voltage range.
3. When performing the reinsertion of fuse holder for the voltage conversion, the appropriate power cord should be used. (See Fig. 1.)





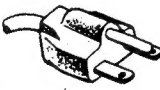
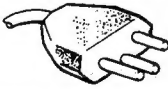
Plug configuration	Power cord and plug type	Factory installed instrument fuse	Line cord plug fuse	Parts No. for power cord and plate
	North American 120 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.3 A, 250 V Slow blow 6×30 mm	None	Cord: E30-1820-05
	Universal Europe 220 volt/50 Hz Rated 16 amp	0.2 A, 250 V Fast blow 6×30 mm	None	Cord: E30-1819-05
	U.K. 240 volt/50 Hz Rated 13 amp	0.2 A, 250 V Fast blow 6×30 mm	0.8 A Type C	—
	Australian 240 volt/50 Hz Rated 10 amp	0.2 A, 250 V Fast blow 6×30 mm	None	Cord: E30-1821-05
	North American 240 volt/60 Hz Rated 15 amp (12 amp max; NEC)	0.2 A, 250 V Fast blow 6×30 mm	None	—
	Switzerland 240 volt/50 Hz Rated 10 amp	0.2 A, 250 V Fast blow 6×30 mm	None	—

Fig. 1 Power Input Voltage Configuration

ADJUSTMENT

CASE DISASSEMBLY AND ASSEMBLY

1. To open the case, turn the unit upside down with the rubber feet facing up. (See Fig. 2)
2. Remove the four screws from the bottom case.
3. Carefully separate the two halves of the case and recalibrate the unit following the prescribed procedure.

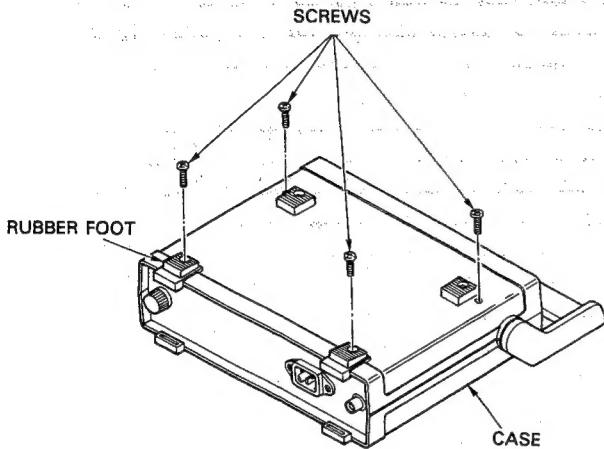


Fig. 2

4. To close the case, lower the bottom case and guide the front and rear panels into their slots. Position the rubber feet as illustrated and screw the two halves of the case together.

Do not overtighten screws.

100/120/220/240 VOLT CONVERSION

This instrument operates from a 100 V, 120 V, 220 V or 240 V AC, 50 to 60 Hz line-voltage source. The applied voltage is indicated on the rear panel. To convert from the specified voltage to other line voltages, replace the voltage plug position on PC Board, referring to the figure below and change the rear panel applied voltage indication. Also, be sure to replace the fuse to correspond to the line voltage 0.3 A slow-blow fuse for 100 V to 120 V operation and 0.2 A fast-blow fuse for 220 V to 240 V operation. If it is not wired to your local line voltage, set the power transformer wiring as shown below. (See Fig. 3.)

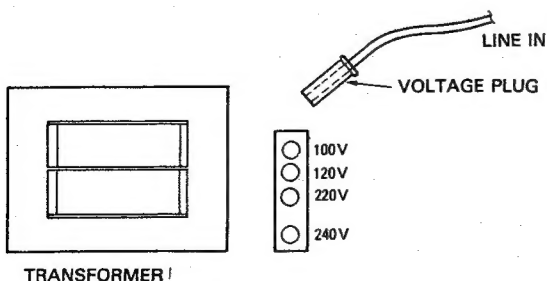


Fig. 3

TEST EQUIPMENT REQUIRED

- Digital Multimeter: KENWOOD DL-707 or equivalent
- Oscilloscope: KENWOOD CS-1022 or equivalent
- Frequency Counter: KENWOOD FC-756 or equivalent
- Distortion Analyzer: Y.H.P 334A or equivalent
- DC Power Supply: KENWOOD PD18-10 or equivalent

AMPLIFIER INTERNAL DC OFFSET AND TRIANGLE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to OFF position, load 50 ohms.
2. Push range switch to OFF position, ATT switch OFF.
3. Amplitude to minimum.
4. Adjust R88 to get -5 mV at the main out BNC jack.
5. Push function switch to "TRIANGLE WAVE", setting amplitude VR at maximum.
6. Push range switch to 100 kHz.
7. Tuning the frequency dial to 1.0 position approximately.
8. Adjust the resistor R91 to get 10.4 ± 0.1 Vp-p main output level and make sure the wave form are not clipping.
9. Check all range except MHz that triangle wave output amplitude more than 10.25 Vp-p.
10. Re-adjust resistor R91 to obtain 10.25 Vp-p output at any critical frequency point.
11. Repeat step 1 to 4 to maintain -5 mV DC voltage at main output BNC.

TRIANGLE WAVE FREQUENCY RESPONSE ADJUSTMENT

1. Push function switch to "TRIANGLE WAVE".
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning the frequency dial to 2.0 position approximately.
4. Load 50 ohms and ATT switch OFF.
5. Adjust the C13 to get 10.4 ± 0.1 V main output level and make sure the wave form are not clipping.

SQUARE WAVE RISE & FALL TIME ADJUSTMENT

1. Push function switch to "SQUARE WAVE", amplitude VR MAX.
2. Push range switch to 100 kHz.
3. Tuning frequency dial to 2.0 position.
4. Load 50 ohms, ATT switch OFF.
5. In maximum output amplitude condition, adjust C25 to reduce over shoot phenomenon.
6. Push range switch to 1 MHz, check rise/fall time for less than 100 ns.
7. Repeat step 5, 6 to minimize over shoot and maintain rise/fall time.

SQUARE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to "SQUARE WAVE".
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning frequency dial to 2.0 position.
4. Load 50 ohms, ATT switch OFF.
5. Adjust R79 (square wave output amplitude) to get 10.4 ± 0.1 Vp-p main output level.

ADJUSTMENT

SINE WAVE AMPLITUDE ADJUSTMENT

1. Push function switch to "SINE WAVE".
2. Push range switch to 100 kHz, dial scale setting at 1.0 position.
3. Load 50 ohms, ATT switch OFF, amplitude VR MAX.
4. Adjust R75 (sine wave output amplitude) to get 10.4 ± 0.1 Vp-p level from main output and make sure the waveform do not clip on the top and bottom.

SINE WAVE, FREQUENCY RESPONSE ADJUSTMENT

1. Push function switch to "SINE WAVE".
2. Push range switch to 1 M, amplitude VR MAX.
3. Turn the frequency dial to 2.0 position approximately.
4. Load 50 ohms, ATT switch OFF.
5. Adjust C23 (sine wave response) to get 10.4 ± 0.1 Vp-p level from main output and make sure the signal are not clipping.

SINE WAVE DISTORTION ADJUSTMENT

Set sweep width VR, rate VR, duty VR, offset VR to minimum situation. Offset VR press in to internal offset position.

1. Push function switch to "SINE WAVE".
2. Push range switch to 100 kHz.
3. Tuning frequency dial to 0.2 position.
4. Adjust R35 make potential equal (within ± 10 mV) between Q5 gate and pin 10 of U5.
5. Adjust R11, R19 make DC voltage equal between pin 2 and pin 3 of both U1 and U2.
6. Push range switch to 100 Hz, adjust R45 CW to MAX.
7. Adjust R48 to reduce 20 Hz distortion.
8. Readjust R45 to reduce 20 Hz distortion.
9. Repeat step 7 and 8 to minimize 20 Hz distortion for less than 0.8%.
10. Push range switch to 100 kHz, setting frequency dial to 1.0 position.
11. Check distortion of 100 kHz for less than 0.8%.
12. Repeat step 7 to 8 for maintain distortion less than 0.8%.

FREQUENCY ACCURACY ADJUSTMENT

1. Push function switch to triangle wave.
2. Push range switch to 100 kHz, amplitude VR MAX.
3. Tuning frequency VR to 2.0 position.
4. Adjust R7 for a counter display reading 200 kHz.
5. Check all ranges accuracy and function are in full scale $\pm 4.5\%$.
6. Repeat steps 4 and 5.
7. Tuning frequency VR to 0.2 position.
8. Check all function and frequency except MHz range frequency accuracy are in full scale $\pm 4.5\%$.
9. Repeat steps 3 to 7 to complete step 8.

1 M RANGE FREQUENCY ADJUSTMENT

1. Push function switch to triangle wave.
2. Push range switch to 1 MHz, amplitude VR MAX.
3. Tuning frequency VR to 2.0 position.
4. Adjust C8 for a counter display reading 2 MHz.
5. Tuning frequency VR to 0.2 position.
6. Check all function frequency accuracy is in full scale $\pm 4.5\%$.
7. Repeat steps 3 to 5 to complete step 6.

COUNTER SENSITIVITY ADJUSTMENT

1. Push the counter INT/EXT switch to EXT mode, dial scale setting at cw max.
2. Set range switch at 1 M range. amplitude VR max, function switch setting at triangle.
3. Adjust R159 to make reading ".0" with no signal input to EXT counter input BNC jack.
4. Check counter sensitivity by 10 MHz 30 mV RMS.
5. Repeat step 3 and 4 to maintain both sensitivity spec and repress interfere of signal generator circuit.

COUNTER ACCURACY ADJUSTMENT

1. Warm-up the instrument at least thirty minutes.
2. Input 10 MHz 30 mVrms sine wave to EXT counter BNC connector.
3. Push the range mode switch to 1 k range (gate time 1 s) adjust C43 SVC to 000.000 kHz (OVER LED lights on simultaneously).

LOG SWEEP WIDTH ADJUSTMENT

1. Pull rate control VR and turn C.W.
2. Connect oscilloscope input to TP1.
3. Adjust R176 (470 ohm) to get $+13.5/-0.5$ V log wave form.

PARTS LIST

MISCELLANEOUS			REF.NO	PARTS NO	NAME & DESCRIPTION
REF.NO	PARTS NO	NAME & DESCRIPTION	D061	1N4148	DIODE
	A02-0522-08	TOP CASE	D062	1N4148	DIODE
	A02-0523-08	BOTTOM CASE	D063	1N4148	DIODE
	A21-1132-08	DECORATIVE PANEL	D064	1N4148	DIODE
	A22-0869-08	SUB PANEL	D065	1N4148	DIODE
	A23-1686-08	REAR PANEL	D066	B30-0959-08	LED,RED
	B41-0800-08	CAUTION LABEL	D067	1N4148	DIODE
	B50-7660-00	INSTRUCTION MANUAL(JAPANESE)	D068	1N4148	DIODE
	B50-7664-00	INSTRUCTION MANUAL(ENGLISH)	D069	B30-0959-08	LED,RED
	E02-0103-15	IC SOCKET 14 PIN	D070	1N4148	DIODE
	E02-0139-05	IC SOCKET 28 PIN	D071	1N4148	DIODE
	E04-0251-05	BNC RECEPTACLE	D072	1N4148	DIODE
	E18-0351-05	AC INLET 3 P	D073	1N4148	DIODE
	E22-0482-08	CONNECTOR 4P(SELECT VOLTAGE)	D074	1N4001	DIODE
	E30-1644-15	BS POWER CORD	D075	1N4001	DIODE
	E30-1818-05	JIS POWER CORD	D076	1N4001	DIODE
	E30-1819-05	CEE POWER CORD	D077	1N4001	DIODE
	E30-1821-05	SAA POWER CORD	D080	1N4001	DIODE
	E31-2931-08	WIRE ASS'Y 1P (FUSE TO PIN)	D081	1N4001	DIODE
	E31-2932-08	WIRE ASS'Y 3P (J1,J4,J5)	D082	RDB,2E(B2)	DIODE, ZENER 8.2V
	E31-2933-08	WIRE ASS'Y 2P (J3)	D083	1N4001	DIODE
	E31-2934-08	WIRE ASS'Y 2P (J2)	Q001	2SC1815(GR)	TR. SI, NPN
	E31-2940-08	SHIELD CABLE 110MM	Q002	2SA1015(GR)	TR. SI, PNP
	E31-2942-08	SHIELD CABLE 130MM	Q003	2SA1015(GR)	TR. SI, PNP
	E31-2943-08	SHIELD CABLE 170MM	Q004	2SC1815(GR)	TR. SI, NPN
	E40-7025-08	PIN CONNECTOR 8 P	Q005	2N5485	FET, N-CHANNEL
	E40-7026-08	PIN CONNECTOR 6 P	Q006	2SA1015(GR)	TR. SI, PNP
	E40-7029-08	PIN CONNECTOR 3 P	Q007	2SA1015(GR)	TR. SI, PNP
	E40-7030-08	PIN CONNECTOR 2 P	Q008	2SC1674(K)	TR. SI, NPN
	F02-0517-08	HEAT SINK 19X19X10H	Q009	2SC1674(K)	TR. SI, NPN
	F02-0518-08	HEAT SINK H=15MM	Q010	2N3906	TR. SI, PNP
	F05-2012-05	FUSE 0.2A(FAST BLOW)	Q011	2SC1674(K)	TR. SI, NPN
	F05-3017-05	FUSE 0.3A(SLOW BLOW)	Q012	2N2219A	TR. SI, NPN
	F09-0515-04	SHEET(COVERED ON CAUTION LABEL	Q013	2N2905A	TR. SI, PNP
	F20-0670-08	INSULATED FIBER	Q016	LM7815	IC, 3-TERMINAL POSI. REGULATOR
	F20-0671-08	INSULATOR FIBER 40X30X0.5T	Q017	TIP32B	TR. SI, PNP
	G02-0612-08	COIL SPRING	Q018	8050C	TR.
	G13-0724-08	SPONGE 20X40	Q019	2N3906	TR. SI, PNP
	G13-0725-08	SPONGE 20X30X1T	Q020	2SC1815(GR)	TR. SI, NPN
	G16-0615-08	SHIELD PAPER	Q021	2SC1815(GR)	TR. SI, NPN
	H01-5885-08	CARTON BOX	Q022	2SA1015(GR)	TR. SI, PNP
	H12-0571-08	FOAMED PAD	Q023	2SC1815(GR)	TR. SI, NPN
	H20-1728-08	VIYNL COVER 320X340X0.06	Q024	LM7805	IC, 3-TERMINAL POSI. REGULATOR
	J02-0520-08	RUBBER FOOT(FRONT)	Q025	2SA1015(GR)	TR. SI, PNP
	J02-0521-08	RUBBER FOOT(REAR)	Q026	2SA1015(GR)	TR. SI, PNP
	J13-0507-08	FUSE HOLDER	Q027	2SA1015(GR)	TR. SI, PNP
	J25-5246-08	PCB (UNMOUNTED) 169X220	Q028	2N5485	FET, N-CHANNEL
	J25-5247-08	PCB (UNMOUNTED) 160X37	Q029	2SC1815(GR)	TR. SI, NPN
	J25-5248-08	PCB (UNMOUNTED) 86X37	Q055	B30-0960-08	DISPLAY(ORANGE)
	J25-5281-08	PCB (UNMOUNTED) 23X63	Q056	B30-0960-08	DISPLAY(ORANGE)
	J30-0622-08	TRANSISTOR HOLDER	Q057	B30-0960-08	DISPLAY(ORANGE)
	J32-0882-08	HEX STUD L=44.2	Q058	B30-0960-08	DISPLAY(ORANGE)
	K01-0527-08	HANDLE	Q059	B30-0960-08	DISPLAY(ORANGE)
	K23-0810-08	KNOB	Q060	B30-0960-08	DISPLAY(ORANGE)
	K27-0541-08	PUSH BUTTON(POWER SWITCH)	U001	UA741	IC, OP AMP.
	K27-0542-08	PUSH BUTTON,WHITE	U002	UA741	IC, OP AMP.
	L01-9726-08	POWER TRANSFORMER	U003	UA308	IC, OP AMP.
	L77-1035-08	CRYSTAL 10MHZ	U004	UA308	IC, OP AMP.
	N09-0758-08	TAPPING SCREW(FRONT FOOT)3.5X8	U005	CA3086	IC, NPN TRANSISTOR ARRAY
	S40-1523-08	PUSH SWITCH(POWER) TV-3	U006	SN7420N	IC, DUAL 4-INPUT NAND GATE
	S42-0505-08	PUSH SWITCH(RANGE FUNCTION)	U007	SN7426N	IC, QUAD. 2-INPUT NAND GATE
	S42-2515-08	PUSH SWITCH(COUNTER ATTENUATOR	U008	CA3030	IC, OP AMP.
	W02-0454-08	MAIN UNIT(MOUNTED)	U009	UA741	IC, OP AMP.
	W02-0455-08	DISPLAY UNIT(MOUNTED)	U010	LM358	IC, DUAL OP AMP.
	W02-0456-08	EXT VCF UNIT(MOUNTED)	U011	LM358	IC, DUAL OP AMP.
	W02-0457-08	ATT. UNIT(MOUNTED)	U012	UA741	IC, OP AMP.
			U013	ICM7216D	IC,8-DIGIT FREQ. COUNTER/TIMER
			U014	MC14066	IC, QUAD. ANALOG SW/QUAD. MPX
			U015	MC10116P	IC, TRIPLE LINE RECEIVER
			U016	UA741	IC, OP AMP.
REF.NO	PARTS NO	NAME & DESCRIPTION	D048	1N4148	DIODE
	D001	1N4148	D049	1N4747A	DIODE, ZENER 20V
			D050	1N4148	DIODE
			D051	B30-0959-08	LED,RED
			D052	1N4148	DIODE
			D053	1N4148	DIODE
			D054	B30-0959-08	LED,RED

PARTS LIST

RESISTOR

REF.NO	PARTS NO	NAME & DESCRIPTION
R001	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R002	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R003	RD148B2C152J	RES. CARBON 1.5K 5% 1/6W
R004	NO USE	
R005	R01-2522-08	V.R. 5KB
R006	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R007	R12-3040-05	RES. SEMI FIXED 22K B
R008	RD148B2C393J	RES. CARBON 39K 5% 1/6W
R009	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R010	RN148K2C3322F	RES. METAL FILM 33.2K 1% 1/6W
R011	R12-3041-05	RES. SEMI FIXED 10KB
R012	RN148K2C3011F	RES. METAL FILM 3.01K 1% 1/6W
R013	RN148K2C4990F	RES. METAL FILM 499 1% 1/6W
R014	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R015	RN148K2C4990F	RES. METAL FILM 499 1% 1/6W
R016	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R017	RN148K2C1003F	RES. METAL FILM 100K 1% 1/6W
R018	RN148K2C4992F	RES. METAL FILM 49.9K 1% 1/6W
R019	R12-3041-05	RES. SEMI FIXED 10KB
R020	RN148K2C3011F	RES. METAL FILM 3.01K 1% 1/6W
R021	R01-4508-08	V.R. WITH SW 50KB
R022	RN148K2C4991F	RES. METAL FILM 4.99K 1% 1/6W
R023	RN148K2C7151F	RES. METAL FILM 7.15K 1% 1/6W
R024	RN148K2C3480F	RES. METAL FILM 348 1% 1/6W
R025	RN148K2C7502F	RES. METAL FILM 75K 1% 1/6W
R026	RN148K2C7503F	RES. METAL FILM 750K 1% 1/6W
R027	RN148K2C4991F	RES. METAL FILM 4.99K 1% 1/6W
R028	RN148K2C7151F	RES. METAL FILM 7.15K 1% 1/6W
R029	RN148K2C3480F	RES. METAL FILM 348 1% 1/6W
R030	RN148K2C7502F	RES. METAL FILM 75K 1% 1/6W
R031	RN148K2C7503F	RES. METAL FILM 750K 1% 1/6W
R032	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R033	RD148B2C102J	RES. CARBON 1K 5% 1/6W
R034	RD148B2C471J	RES. CARBON 470 5% 1/6W
R035	R12-1028-05	RES. SEMI FIXED 4.7KB
R036	RD148B2C272J	RES. CARBON 2.7K 5% 1/6W
R037	RN148K2C1001F	RES. METAL FILM 1K 1% 1/6W
R038	RN148K2C1001F	RES. METAL FILM 1K 1% 1/6W
R039	RN148K2C4021F	RES. METAL FILM 4.02K 1% 1/6W
R040	RN148K2C4021F	RES. METAL FILM 4.02K 1% 1/6W
R041	RN148K2C2001F	RES. METAL FILM 2K 1% 1/6W
R042	RN148K2C3012F	RES. METAL FILM 30.1K 1% 1/6W
R043	RN148K2C1002F	RES. METAL FILM 10K 1% 1/6W
R044	RN148K2C4990F	RES. METAL FILM 499 1% 1/6W
R045	R12-1033-05	RES. SEMI FIXED 2.2K B
R046	RN148K2C1302F	RES. METAL FILM 13K 1% 1/6W
R047	RN148K2C1302F	RES. METAL FILM 13K 1% 1/6W
R048	R12-1033-05	RES. SEMI FIXED 2.2K B
R049	RD148B2C910J	RES. CARBON 91 5% 1/6W
R050	RD148B2C272J	RES. CARBON 2.7K 5% 1/6W
R051	RD148B2C272J	RES. CARBON 2.7K 5% 1/6W
R052	NO USE	
R053	RN148K2C7501F	RES. METAL FILM 7.5K 1% 1/6W
R054	R92-1061-05	JUMPING RES. ZERO OHM
R055	RS14AB3A391J	RES. METAL FILM 390 5% 1W
R056	R01-1518-08	V.R. WITH SW 1KB
R057	RD148B2C391J	RES. CARBON 390 5% 1/6W
R058	RD148B2C470J	RES. CARBON 47 5% 1/6W
R059	RN148K2C499F	RES. METAL FILM 49.9 1% 1/6W
R060	RN148K2C1132F	RES. METAL FILM 11.3K 1% 1/6W
R061	RN148K2C1132F	RES. METAL FILM 11.3K 1% 1/6W
R062	RN148K2C3090F	RES. METAL FILM 309 1% 1/6W
R063	RN148K2C1212F	RES. METAL FILM 12.1K 1% 1/6W
R064	RN148K2C1212F	RES. METAL FILM 12.1K 1% 1/6W
R065	RN148K2C2000F	RES. METAL FILM 200 1% 1/6W
R066	RN148K2C2492F	RES. METAL FILM 24.9K 1% 1/6W
R067	RN148K2C2492F	RES. METAL FILM 24.9K 1% 1/6W
R068	RN148K2C1270F	RES. METAL FILM 127 1% 1/6W
R069	RD148B2C102J	RES. CARBON 1K 5% 1/6W
R070	RN148K2C63R4F	RES. METAL FILM 63.4 1% 1/6W
R071	RD148B2C512J	RES. CARBON 5.1K 5% 1/6W
R072	RD148B2C102J	RES. CARBON 1K 5% 1/6W
R073	RD148B2C681J	RES. CARBON 680 5% 1/6W
R074	RD148B2C151J	RES. CARBON 150 5% 1/6W
R075	R12-1029-05	RES. SEMI FIXED 1K B
R076	RD148B2C682J	RES. CARBON 6.8K 5% 1/6W
R077	RN148K2C1052F	RES. METAL FILM 10.5K 1% 1/6W
R078	RN148K2C1052F	RES. METAL FILM 10.5K 1% 1/6W
R079	R12-1033-05	RES. SEMI FIXED 2.2K B
R080	RN148K2C1001F	RES. METAL FILM 1K 1% 1/6W

REF.NO	PARTS NO	NAME & DESCRIPTION
R081	RD148B2C331J	RES. CARBON 330 5% 1/6W
R082	R01-1517-08	V.R. 1KB
R083	RD148B2C150J	RES. CARBON 15 5% 1/6W
R084	RN148K2C2001F	RES. METAL FILM 2K 1% 1/6W
R085	RN148K2C1500F	RES. METAL FILM 150 1% 1/6W
R086	RD148B2C122J	RES. CARBON 1.2K 5% 1/6W
R087	RD148B2C432J	RES. CARBON 4.3K 5% 1/6W
R088	R12-1033-05	RES. SEMI FIXED 2.2K B
R089	RD148B2C512J	RES. CARBON 5.1K 5% 1/6W
R090	RN148K2C2552F	RES. METAL FILM 25.5K 1% 1/6W
R091	R12-1029-05	RES. SEMI FIXED 1K B
R092	RD148B2C183J	RES. CARBON 18K 5% 1/6W
R093	RN148K2C3160F	RES. METAL FILM 316 1% 1/6W
R094	RD148B2C101J	RES. CARBON 100 5% 1/6W
R095	RD148B2C302J	RES. CARBON 3K 5% 1/6W
R096	RD148B2C333J	RES. CARBON 33K 5% 1/6W
R097	RD148B2C302J	RES. CARBON 3K 5% 1/6W
R098	RS14AB3A150J	RES. METAL FILM 15 5% 1W
R099	RS14AB3A150J	RES. METAL FILM 15 5% 1W
R100	RS14AB3D470J	RES. METAL FILM 47 5% 2W
R101	NO USE	
R102	RS14AB3F620J	RES. METAL FILM 62 5% 3W
R103	RS14AB3F620J	RES. METAL FILM 62 5% 3W
R104	RN148K2C41R2F	RES. METAL FILM 41.2 1% 1/6W
R105	RN148K2C41R2F	RES. METAL FILM 41.2 1% 1/6W
R106	RN148K2C10R0F	RES. METAL FILM 10.0 1% 1/6W
R107	RN148K2C49R9F	RES. METAL FILM 49.9 1% 1/6W
R108	RN148K2C49R9F	RES. METAL FILM 49.9 1% 1/6W
R109	R92-1425-08	RES. METAL FILM 1 1% 1/6W
R110	NO USE	
R111	RD148B2C102J	RES. CARBON 1K 5% 1/6W
R112	RD148B2C102J	RES. CARBON 1K 5% 1/6W
R113	RN148K2C1102F	RES. METAL FILM 11K 1% 1/6W
R114	RN148K2C1102F	RES. METAL FILM 11K 1% 1/6W
R115	RD148B2C222J	RES. CARBON 2.2K 5% 1/6W
R116	R01-3521-08	V.R. WITH SW 10KB
R117	RD148B2C150J	RES. CARBON 15 5% 1/6W
R118	RD148B2C393J	RES. CARBON 39K 5% 1/6W
R119	RD148B2C512J	RES. CARBON 5.1K 5% 1/6W
R120	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R121	RD148B2C512J	RES. CARBON 5.1K 5% 1/6W
R122	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R123	RD148B2C222J	RES. CARBON 2.2K 5% 1/6W
R124	RD148B2C153J	RES. CARBON 15K 5% 1/6W
R125	RD148B2C681J	RES. CARBON 680 5% 1/6W
R126	RD148B2C272J	RES. CARBON 2.7K 5% 1/6W
R127	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R128	RD148B2C514J	RES. CARBON 510K 5% 1/6W
R129	RD148B2C514J	RES. CARBON 510K 5% 1/6W
R130	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R131	RD148B2C512J	RES. CARBON 5.1K 5% 1/6W
R132	RD148B2C101J	RES. CARBON 100 5% 1/6W
R133	RD148B2C222J	RES. CARBON 2.2K 5% 1/6W
R134	RD148B2C222J	RES. CARBON 2.2K 5% 1/6W
R135	R92-1423-08	RES. METAL GLAZE 22M 5% 1/6W
R136	RD148B2C333J	RES. CARBON 33K 5% 1/6W
R137	RD148B2C222J	RES. CARBON 2.2K 5% 1/6W
R138	RD148B2C154J	RES. CARBON 150K 5% 1/6W
R139	RD148B2C750J	RES. CARBON 75 5% 1/6W
R140	RD148B2C750J	RES. CARBON 75 5% 1/6W
R141	RD148B2C101J	RES. CARBON 100 5% 1/6W
R142	RD148B2C101J	RES. CARBON 100 5% 1/6W
R143	RD148B2C101J	RES. CARBON 100 5% 1/6W
R144	RD148B2C220J	RES. CARBON 22 5% 1/6W
R145	RD148B2C101J	RES. CARBON 100 5% 1/6W
R146	RD148B2C471J	RES. CARBON 470 5% 1/6W
R147	RD148B2C471J	RES. CARBON 470 5% 1/6W
R148	RD148B2C221J	RES. CARBON 220 5% 1/6W
R149	RD148B2C331J	RES. CARBON 330 5% 1/6W
R150	RD148B2C471J	RES. CARBON 470 5% 1/6W
R151	RD148B2C471J	RES. CARBON 470 5% 1/6W
R152	RD148B2C331J	RES. CARBON 330 5% 1/6W
R153	RD148B2C331J	RES. CARBON 330 5% 1/6W
R154	RD148B2C471J	RES. CARBON 470 5% 1/6W
R155	RD148B2C471J	RES. CARBON 470 5% 1/6W
R156	RD148B2C104J	RES. CARBON 100K 5% 1/6W
R157	RD148B2C471J	RES. CARBON 470 5% 1/6W

PARTS LIST

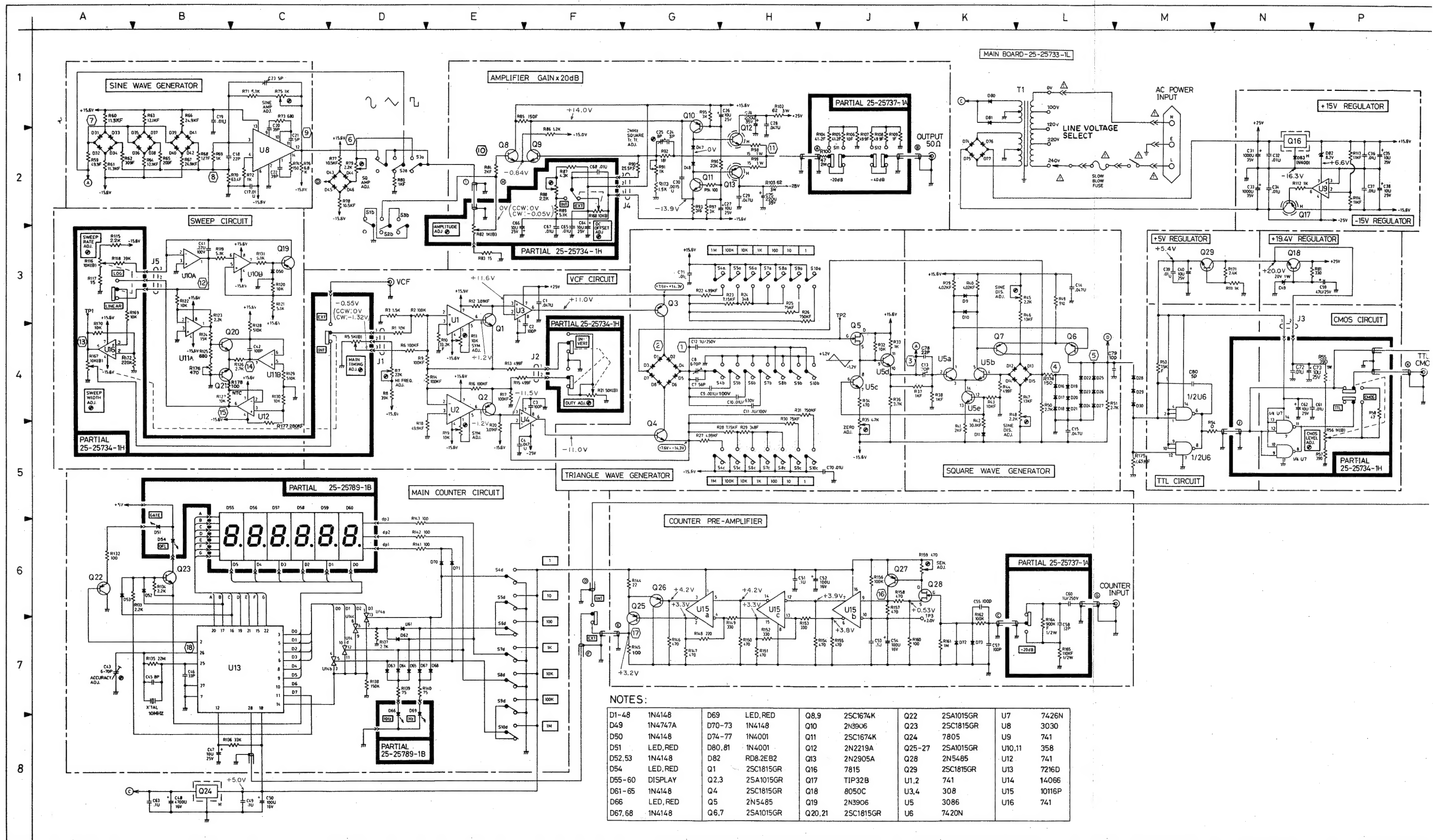
REF.NO	PARTS NO	NAME & DESCRIPTION
R158	RD148B2C471J	RES. CARBON 470 5% 1/6W
R159	R12-0058-05	RES. SEMI FIXED 470 B
R160	RD148B2C101J	RES. CARBON 100 5% 1/6W
R161	RD148B2C105J	RES. CARBON 1M 5% 1/6W
R162	RD148B2C104J	RES. CARBON 100K 5% 1/6W
R163	NO USE	
R164	R92-1424-08	RES. METAL FILM 900K 1% 1/6W
R165	RN148K2H1103F	RES. METAL FILM 110K 1% 1/2W
R166	NO USE	
R167	R01-3521-08	V.R. WITH SW 10KB
R168	R01-3521-08	V.R. WITH SW 10KB
R169	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R170	RD148B2C103J	RES. CARBON 10K 5% 1/6W
R171	RD148B2C242J	RES. CARBON 2.4K 5% 1/6W
R172	RD148B2C224J	RES. CARBON 220K 5% 1/6W
R173	RD148B2C152J	RES. CARBON 1.5K 5% 1/6W
R174	RD148B2C151J	RES. CARBON 150 5% 1/6W
R175	RN148K2C1651F	RES. METAL FILM 1.65K 1% 1/6W
R176	R12-0058-05	RES. SEMI FIXED 470 B
R177	RN148K2C2803F	RES. METAL FILM 280K 1% 1/6W
R178	R92-1430-08	TERMISTOR.NTC 100 OHM

CAPACITOR

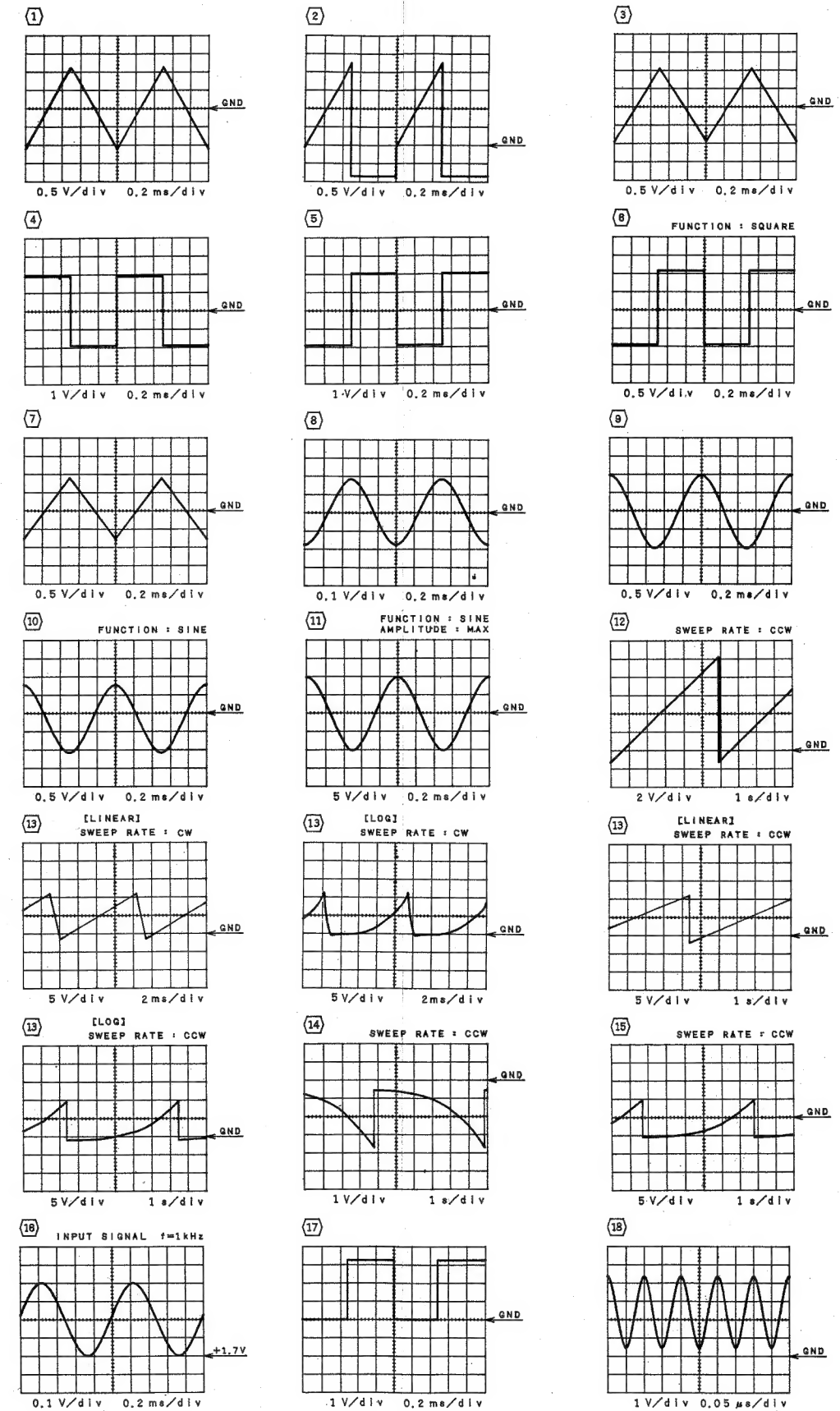
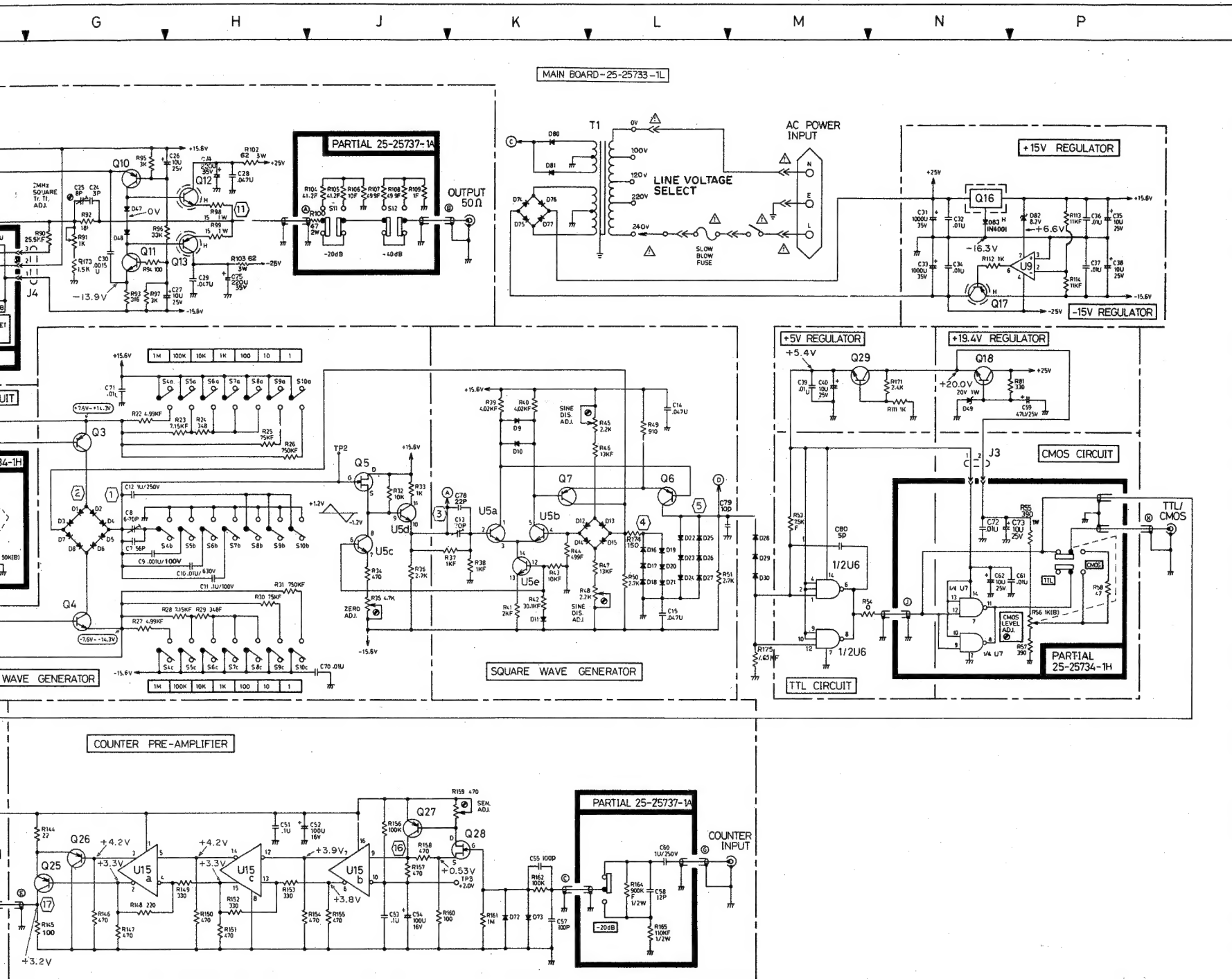
REF.NO	PARTS NO	NAME & DESCRIPTION
C001	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C002	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C003	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C004	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C007	CC45CH1H560J	CAP. CERAMIC 56P 5% 50V
C008	C05-0451-08	CAP. TRIMMER 70PF
C009	C91-1259-08	CAP. POLYE FILM 0.001 2% 100V
C010	C91-1258-08	CAP. METAL FILM 0.01 2% 630V
C011	C91-1257-08	CAP. METAL FILM 0.1 2% 100V
C012	C91-1262-08	CAP. METAL FILM 1 2% 250V
C013	C05-0466-08	CAP. TRIMMER 70PF
C014	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C015	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C016	NO USE	
C017	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C018	CC45CH1H220J	CAP. CERAMIC 22P 5% 50V
C019	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C020	CC45CH1H390J	CAP. CERAMIC 39P 5% 50V
C021	CC45CH1H050C	CAP. CERAMIC 5P 0.25P 50V
C022	CC45CH1H390J	CAP. CERAMIC 39P 5% 50V
C023	C05-0465-08	CAP. TRIMMER 5PF
C024	CC45CH1H030C	CAP. CERAMIC 3P 0.25P 50V
C025	C05-0450-08	CAP. TRIMMER 8PF
C026	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C027	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C028	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C029	CK45F1H473Z	CAP. CERAMIC 0.047 50V
C030	CK45B1H152K	CAP. CERAMIC 1500P 10% 50V
C031	CE04EW1V102M	CAP. ELECTRO 1000 20% 35V
C032	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C033	CE04EW1V102M	CAP. ELECTRO 1000 20% 35V
C034	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C035	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C036	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C037	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C038	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C039	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C040	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C041	C91-1260-08	CAP. METAL FILM 0.22 10% 100V
C042	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C043	C05-0451-08	CAP. TRIMMER 70PF
C044	NO USE	
C045	CC45CH1H080D	CAP. CERAMIC 8P 0.5P 50V
C046	CC45CH1H330J	CAP. CERAMIC 33P 5% 50V
C047	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C048	CE04EW1C472M	CAP. ELECTRO 4700 20% 16V
C049	C91-1261-08	CAP. /MULTILAYER 0.1 100V
C050	CE04EW1C101M	CAP. ELECTRO 100 20% 16V
C051	CK45F1H104Z	CAP. CERAMIC 0.1 50V
C052	CE04EW1C101M	CAP. ELECTRO 100 20% 16V
C053	CK45F1H104Z	CAP. CERAMIC 0.1 50V
C054	CE04EW1C101M	CAP. ELECTRO 100 20% 16V
C055	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C056	NO USE	

REF.NO	PARTS NO	NAME & DESCRIPTION
C057	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C058	CC45CH1H120J	CAP. CERAMIC 12P 5% 50V
C059	CE04EW1E470M	CAP. ELECTRO 47 20% 25V
C060	C91-1256-08	CAP. METAL FILM 1 10% 250V
C061	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C062	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C063	CK45F1H104Z	CAP. CERAMIC 0.1 50V
C064	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C065	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C066	CE04EW1E100M	CAP. ELECTRO 10 20% 25V
C067	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C068	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C069	NO USE	
C070	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C071	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C072	CK45F1H103Z	CAP. CERAMIC 0.01 50V
C073	CE04EW1E100M	CAP. ELECTRO 10 20

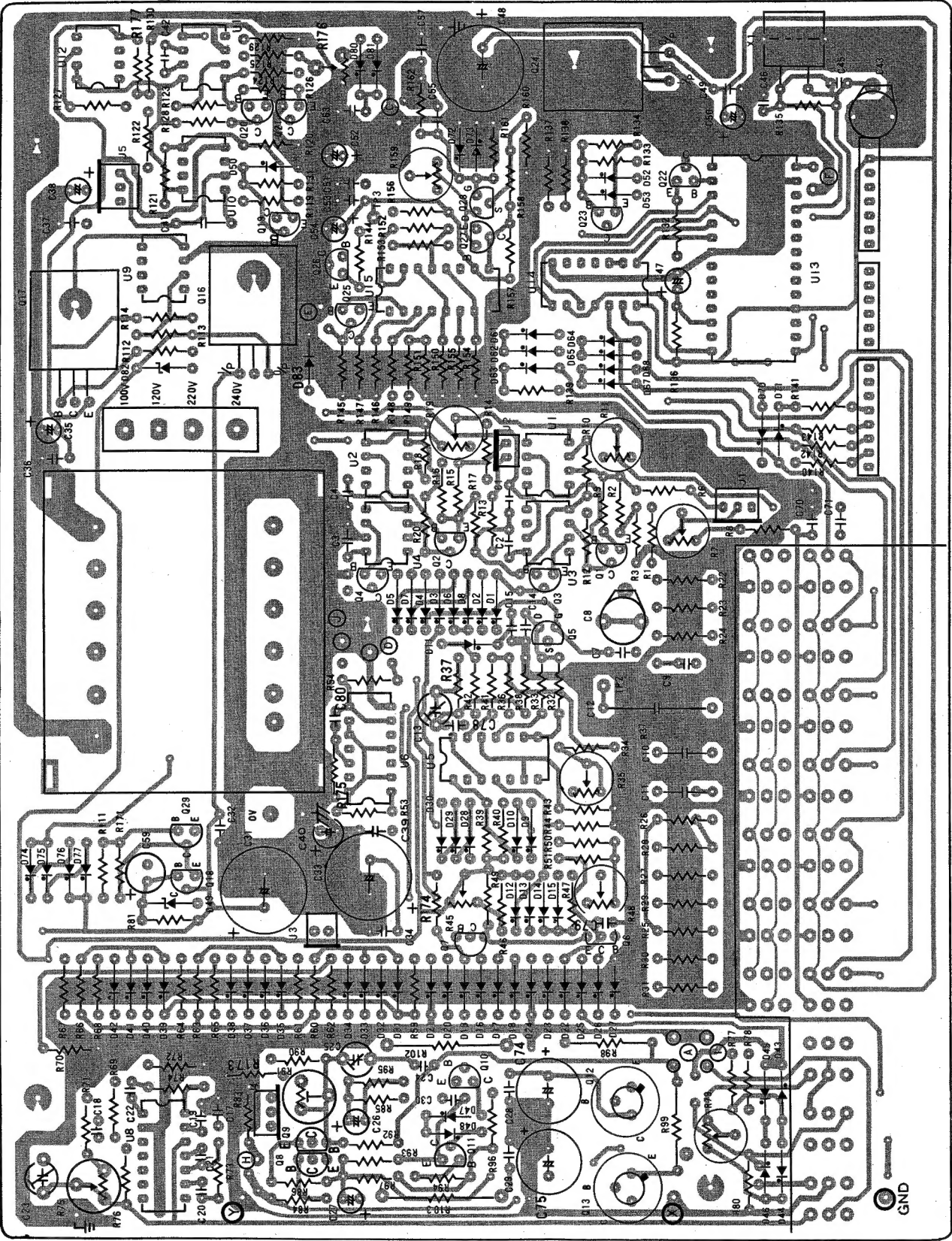
SCHEMATIC DIAGRAM



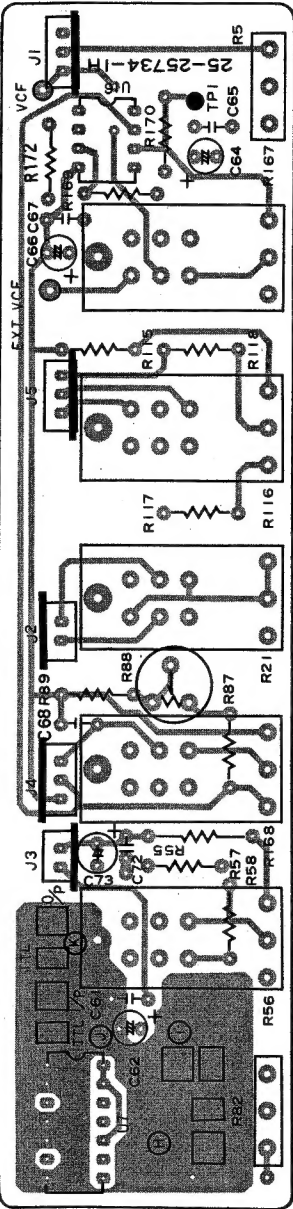
SCHEMATIC DIAGRAM



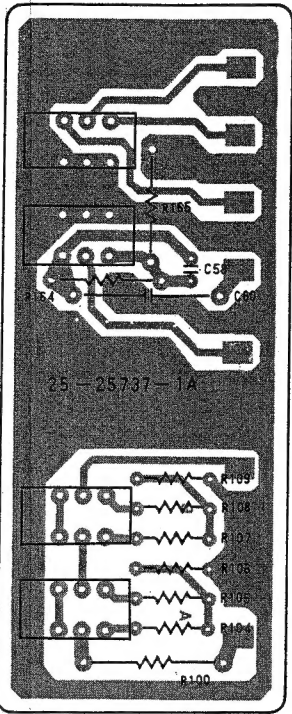
P.C. BOARD



EXT VCF UNIT
(W02-0456-08)



ATT. UNIT
(W02-0457-08)



DISPLAY UNIT
(W02-0455-08)

